GOVERNMENT OF INDIA
MINISTRY OF RAILWAYS
(RAILWAY BOARD)

2024/Proj./CMRL/C1-C2/30/84 New Delhi, dated 08.10.2024

Managing Director,
Chennai Metro Rail Limited (CMRL)
No.327, Anna Salai, Nandanam,
Chennai - 600035, Tamil Nadu.

Sub: Approval of Fastening Systems - Double resilient Base Plate Assembly (Drg no. 13145) and Vossloh 336, (Annexure C-2) for Phase II Project of Chennai Metro Rail Limited (CMRL)

Ref: (i) Annexure C-2 documents uploaded by CMRL on RDSO's online portal on 18.07.2024 along with compliance
(ii) Board's letter no. 2003/Proj./Bangalore/2/2(pt.) dated 07.10.2011
(iii) Board's letter no. 98/Proj./DLI/30/1 (Vol.III) dated 24.01.2013

Please refer to Chennai Metro Rail Limited (CMRL) request for approval for using below mentioned Fastening Systems for Phase II project of Chennai Metro Rail Limited (CMRL).

1. Double resilient Base Plate Assembly FS Drawing no 13145 – Issue Code C (proposed for the below corridors)
   - Corridor 4 - Light House Metro (including Station) to Poonamallee Bypass Metro (including station)
   - Corridor 3 - Madhavaram Milk Colony (including station) to Sipcot II (including station)
   - Corridor 5 - Koyambedu (excluding station) to Elcot (including station)

2. Fastening System 336 (proposed for the below corridor)
   - Corridor 5 – Madhavaram Milk Colony (excluding station) to Koyambedu (including station)

Fastening Systems (Annexure C-2) - Double resilient Base Plate Assembly (Drg no. 13145) and Vossloh 336 for use in above mentioned corridors of Phase II Project of Chennai Metro Rail Limited (CMRL) have been examined in Board's office in consultation with RDSO and approval of the competent authority is hereby conveyed. The salient features of the Fastening Systems are enclosed.

CMRL shall ensure compliance of all the condition stipulated in Board's letter under reference (ii) & (iii) for the subjected Fastening Systems.

Encl: As above

(**F. A. Ahmad**)
Director/Gati Shakti (Civil)-IV
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Copy to:

1. **Executive Director/UTHS**, RDSO, Manak Nagar, Lucknow w.r.t letter No. UT/CMRL/38/PH-II dated 25.07.2024
2. **OSD/UT & Ex-Officio Joint Secretary**, Ministry of Housing & Urban Affairs (MoHUA), Nirman Bhavan, New Delhi-110001

COMPLIANCE MATRIX TO RDSO -ANNEXURE-C2

Name of the Fastening System: **Double Resilient Baseplate Assembly Fastening System, Drawing No 13145-Issue code C (Proposed for the below corridors)**

Corridors:
1. Corridor 4- **Light house Metro (including station) to Poonamallee Bypass Metro (including station)**
2. Corridor 3- **Madhavaram Milk Colony (including station) to Sipcot II (including station)**
3. Corridor 5- **Koyambedu (excluding station) to Elcot (Including station)**

Name of the Fastening System: **Fastening System 336 (Proposed for the below corridor)**

Corridors: **Corridor 5- Madhavaram Milk Colony (excluding station) to Koyambedu (including station)**

PART- A: PERFORMANCE CRITERIA OF FASTENING SYSTEM FOR BALLASTLESS TRACK ON METRO RAILWAYS/MRTS SYSTEM

S. No		RDSO Requirement/Condition	CMRL Compliance	
			Double Resilient Baseplate Assembly Fastening System	Fastening System 336
1		**Purpose and Selection**		
	1.1	The performance criteria define the performance standard of fastening system for ballast less track of Metro Railway System. Apart from other things, the fastening system is required to moderate vibration and noise transmitted through the rail and to reduce the track stiffness and the impact on the track structure, so as to obtain the parameters as detailed in the ensuing paragraphs.	Noted.	Noted.

Examined and found in order
Pradeep Kr. Mishra
ADE/U.T./CIVIL
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Manak Nagar, Lucknow-11

Project Directorate
Approved on 08/10/2024
Railway Board

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METROS, Anna Salai,
Nandanam, Chennai - 600035

S. No		RDSO Requirement/Condition	CMRL Compliance	
			Double Resilient Baseplate Assembly Fastening System	**Fastening System 336**
	1.2	A new fastening system, which is fully compliant to performance criteria and not approved by MoR can also be used by Metro Railways/MRTS system as they are free to choose fastening systems for ballast less track complying with this performance criterion. The detail of such fastening system used shall be submitted to MoR and the same shall be kept in observation by MoR for a period of 2 years under service conditions in association of Metro Railways/MRTS system. The Performa for the monitoring performance shall advised by MoR to concerned Metros Railways/MRTS system. After successful performance for 2 years, Metro Railways/MRTS system shall process for approval of MoR for further use of fastening system.	The proposed fastening system is fully compliant to performance criteria and approved by MoR vide Letter No.2003/proj/Bangalore/2/2(pt), dated 07.10.2011. **(Attached as Annexure 1).**	The proposed fastening system is fully compliant to performance criteria and approved by MoR vide Letter No.98/Proj./DLI/30/1(Vol.III) dated 24.01.2013. **(Attached as Annexure 6)**
	1.3	The fastening system already approved by MOR as per previous performance criteria for ballastless track dated 21.05.2010 will not require fresh clearance as per these revised criteria and any of these systems can be used by Metros/MRTS systems.	Noted	Noted
	1.4	In case Metros Railways/MRTS system opts for a new fastening system for Ballast less track which is not fully compliant to these performance criteria, they will approach MoR for approval before finalizing the use of fastening system.	Noted.	Noted.

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S. No		RDSO Requirement/Condition	CMRL Compliance	
			Double Resilient Baseplate Assembly Fastening System	Fastening System 336
2		**Operating Environment:**		
		Fastening system is expected to perform generally in the following conditions:		
	2.1	Gauge – Broad gauge, 1676/1673mm (nominal) and standard gauge-1435mm.	CMRL is adopting Standard gauge-1435mm.	
	2.2	Speed potential – 110kmph	Maximum speed is 90kmph	
	2.3	Rail section – 60E1, 90 UTS/110UTS	• 60 E1, Grade 1080 HH Confirming to IRS T-12 – 2009 for Mainline • 60 E1, Grade 880 Confirming to IRS T-12 – 2009 for Depot	
	2.4	Static axle load – BG & SG – 20t (max.)	Static axle load – SG – 16t	
	2.5	Design rail temperature range – (-)10degree Celsius to +70 degree Celsius	Complied	
	2.6	Curvature and gradient will be specified in SOD.	**Provisions in SOD have been followed and complied.** **Maximum gradient:** (Compensated) On Mail line, Viaduct and Underground = 4% (including compensation for curve) Maximum gradient at Depot = 4% (including compensation for curve) Station = 0.25%. (including compensation for curve)	
			Minimum vertical curve radius: On Main line (Up & Down line) and Depot connecting track = 1500m	

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S. No		RDSO Requirement/Condition	CMRL Compliance	
			Double Resilient Baseplate Assembly Fastening System	**Fastening System 336**
			Minimum horizontal curve radius: Main running line (Up & Down), ▪ Viaduct = 120m ▪ UG = 200m • Stations = 1000m • Depot = 100 m	
			Maximum SE = 125mm (As per revised SOD) Maximum Cant Deficiency = 100mm	
	2.7	Rail seat inclination(slope)-1 in 20	**Complied**	
		In addition, the client Railway may specify any other operating condition such as support spacing, etc.	Spacing of fastening system- maximum 650mm	
3		**Ballastless Track structure:**	**CMRL Compliance**	**CMRL Compliance**
		Track shall be laid on cast in situ/precast reinforced plinth or slab, herein after referred to as the 'track slab'. The track slab shall be designed as plinth beam or slab type ballast less track structure with derailment guards. The track slab dimensions and the clearance between rail and derailment guard shall be sufficient to accommodate the base plates of the fastening system and facilitate easy and convenient replacement of the fastening system. The clearance between rail and	**Complied.**	**Complied.**

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S. No		RDSO Requirement/Condition	CMRL Compliance	
			Double Resilient Baseplate Assembly Fastening System	Fastening System 336
		derailment guard shall be within the range provided in Annexure C-1.		
		In general, track slab on which the fastening and rail are to be fitted shall:		
		i. Resist the track forces.	**Complied**	**Complied**
		ii. Have adequate edge distance of concrete beyond the anchor bolts to provide resistance against edge failure	**Complied**	**Complied**
		iii. Provide a level base for uniform transmission of rail forces.	Ensured through Track Plinth/slab geometry	Ensured through Track Plinth/slab geometry
		iv. Have geometrical accuracy and enable installation of track to the tolerances laid down.	Ensured through Track Plinth/slab geometry and fastening system adjustability	Ensured through Track Plinth/slab geometry and fastening system adjustability
		v. Ensure drainage.	Ensured through Track Plinth/slab geometry	Ensured through Track Plinth/slab geometry
		vi. Resist weathering.	Sufficient concrete covers ensured.	Sufficient concrete covers ensured.
		vii. Be construction friendly, maintainable and quickly repairable in the event of a derailment. The 'Repair and Maintenance Methods' shall be detailed in a Manual to be prepared and made available.	Concrete Repair Procedure incorporated in the track maintenance manual.	Concrete Repair Procedure will be incorporated in the track maintenance manual.
		viii. Ensure provision for electrical continuity between consecutive plinths/slabs by an appropriate design.	**Complied**	**Complied**

Examined and found in order

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S. No		RDSO Requirement/Condition	CMRL Compliance	
			Double Resilient Baseplate Assembly Fastening System	Fastening System 336
4		**Performance Requirement of Fastening system:**	**CMRL Compliance**	**CMRL Compliance**
	4.1	General		
		i.The fastening shall be designed to hold the two rails of the track strongly to the supporting structure in upright position by resisting the vertical, lateral and longitudinal forces (including thermal forces) and vibrations.	Repeated Loading test conducted –passed (no crack)	Repeated Loading test conducted –passed (no crack)
		ii.The fastenings shall be with a proven track record. The fastening system should have satisfactory performance record of minimum three years in service in regular revenue operation on ballastless track on any two different established railway systems(except exclusive freight tracks) for a length of at least 5km in in each metro having speed potential of at least 80kmph and design axle load 16T irrespective of wheel profile and rail section in this regard, supplier should submit certificate of performance from user railways administration including proof of use of the fastening assembly are having same material and specification in case the proven system is having different rail section and wheel profile along with details of test results as per test plan of Table 1. **Note: For any metro system having design axle load <16T, the above criteria shall be applicable**	Pandrol's Fastening System Ref.13145 Rev. C has been approved by MoR duly considering the proven services across various Metros/Railways.	Vossloh Rail Fastening System 336-Assembly Drg. No. 0.2424d, dated 18.10.2000 has been approved by MoR duly considering the proven services across various Metros/Railways.

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S. No		RDSO Requirement/Condition	CMRL Compliance	
			Double Resilient Baseplate Assembly Fastening System	Fastening System 336
		for the axle load for which the metro system is designed.		
		iii.The fastening shall provide insulation to take care of return current of traction system.	**Complied.**	Complied.
		iv.Fastening should satisfy the required performance norms as stated in para 4.2 4.3,4.4, 4.5& 4.6.	**Complied.**	Complied.
	4.2	Following are the technical performance requirements of fastenings: The Fastening shall		
		i) Have design service life of 30 years in general. However, its components such as rubber pad, rail clip etc. can be designed for 300 GMT or 15 years whichever is less. Anchor bolts or studs used for fixing base plate to the concrete should not be required to be replaced during service life. Its components must not suffer any degradation during service life to a degree so as to affect the performance and safety of the track. Full-service life is to be attained under the following conditions:	**Noted and complied.**	Noted and complied.
		a) Atmospheric ultraviolet radiation	**Complied**	Complied
		b) Proximity of track up to 10 m from saltwater source.	**Complied**	Complied
		c) Contact with oil, grease or distillate dropped from track vehicles.	**Complied**	Complied

Examined and found in order

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S. No		RDSO Requirement/Condition				CMRL Compliance	
						Double Resilient Baseplate Assembly Fastening System	Fastening System 336
		ii) Permit quick and easy installation and replacement with special tools.				**Complied**	Complied
		iii) Be capable of vertical adjustment during service life up to 12mm using shims.				**Complied.**	Complied.
		iv) Permit the attainment of the following tolerances when installed and later, during service.					
		SN	Parameter	Installation	Maintenance		
		1.	Gauge	±2, -1mm	+4, -2mm	**Complied**	Complied
		2.	Cross level on straight track	±1.5 mm	± 5mm	**Complied**	Complied
		3.	Super elevation on curved track	±1.5 mm	±3 mm	**Complied**	Complied
		4.	Vertical alignment over a 20m chord	± 3 mm	±6 mm	**Complied**	Complied
		5.	Lateral alignment over a 20m chord on straight track	± 2 mm	±6 mm	**Complied**	Complied
		6.	On curves-variation over the theoretical versine on 20m chord	± 2 mm	±5 mm	**Complied**	Complied
	4.3	Anchor bolts/studs used for fixing the bearing plate in concrete shall have splayed ends. Detailed calculations for the number of anchor bolts required on tangent and curved tracks shall be furnished by the supplier and approved by the Metro system.				**Complied.** Calculations on the number of Anchor bolts required for tangent and curved tracks are attached in **Annexure -2**.	**Complied.** Calculations on the number of Anchor bolts required for tangent and curved tracks are **attached in Annexure -7.**

Examined and found in order

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S. No		RDSO Requirement/Condition	CMRL Compliance	
			Double Resilient Baseplate Assembly Fastening System	Fastening System 336
	4.4	For all the fastening components as per approved assembly, the supplier shall furnish detail drawings, specifications and inspection and test plan to the Metros. Metros to ensure that components are supplied as per drawings and specifications.	**Complied.**	**Complied.**
	4.5	The supplier should furnish the 'Installation and Maintenance Manual' which shall be approved by the Metro system.	**Noted and complied.**	**Noted and complied.**
	4.6	Any change in component subsequent to the approval of the fastening system by MoR shall be permitted only for the specific requirement of the metro. MoR approval of such changes shall be processed by metro with specific recommendations enclosing test report of the component/ whole assembly with detailed justification.	**Noted.**	**Noted.**
	4.7	The rail fastening system shall be tested to the following specifications (Table 1) for different technical parameters and should meet the acceptance criteria as mentioned in the following table. Test report of the reputed independent institute/laboratory will have to be submitted. The testing is to be done for Cat B as specified in EN-13481-Part-I-2012 & EN-13481-5:2012 with rail section to be used in proposed system if other design particulars are meeting the requirement of Cat-B.	Please refer below for results of tests as per Cat B as specified in EN-13481-Part-I 2012 & EN-13481-5:2012. **(Full test report attached as Annexure - 3)**	Please refer below for results of tests as per Cat B as specified in EN- 13481-Part-I 2012 & EN-13481-5:2012. **(Full test report attached as Annexure -8)**
		1. Longitudinal rail restraint shall be tested as per EN- 13146-1-2012. Acceptance criteria is	**Complied.** Result is 11.7 ±0.2 KN.	**Complied.** Result is 9.5 KN.

Examined and found in order
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08/10/2022

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S. No		RDSO Requirement/Condition	CMRL Compliance	
			Double Resilient Baseplate Assembly Fastening System	Fastening System 336
		7KN(min). This has to be tested before repeated load test.		
		2. Vertical static stiffness of complete fastening assembly to be tested as per EN 13146-4-2012. Acceptance criteria is 35KN/mm(max). No sliding, yield or cracking is allowed for the fastener parts.	**Complied.** Vertical static stiffness of the fastening system tested with result of 24.7 ±0.7 KN/mm.	**Complied.** Vertical static stiffness of the fastening system tested with result of 18.8KN/mm
		3. Dynamic/static stiffness ratio shall be tested as per EN 13481-5-2012. Acceptance criteria is 1.4(max). Ratio is calculated by dividing the dynamic stiffness to static vertical stiffness.	**Complied.** Dynamic to static stiffness ratio is found as 1.1±0.1.	**Complied.** Dynamic to static stiffness ratio is found as 1.1.
		4. Clamping force shall be tested as per EN - 13146-7-2012. Acceptance criteria is 18KN(min) per Rail seat. This has to be tested before repeated load test.	**Complied.** Test result of clamping force is 20.6±0.3KN.	**Complied.** Test result of clamping force is 19.1KN.
		5. Electrical resistivity shall be tested as per EN- 13146-5-2012. Acceptance criteria is 5kΩ(min). Higher value may be specified if required by Metros for track circuit.	**Complied.** Electric resistivity of the system tested with result of 18.3kΩ.	**Complied.** Electric resistivity of the system tested with result of 12.0kΩ.
		6. Effects of severe environmental conditions shall be tested as per EN 13146-6-2012. The fastening assembly shall be capable of being dismantled, without failure of any component & reassembled using manual tools provided for this purpose after exposure to the salt spray test.	**Complied.** The fastening was dismantled and reassembled without failure of any component.	**Complied.** The fastening was dismantled and reassembled without failure of any component.
		7. Effect of repeated loading shall be tested as per EN 13146-4-2012. No wear or deformation.	**Complied.**	**Complied.**

Examined and found in order

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Project Directorate Approved 08/10/2024 Railway Board

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S. No		RDSO Requirement/Condition	CMRL Compliance	
			Double Resilient Baseplate Assembly Fastening System	Fastening System 336
		7a. On vertical static stiffness shall be tested as per EN 13146-4-2012. Variation ≤ 25% of the initial value. No sign of bond failure/fracture/slippage	**Complied.** Variation of the initial value is observed as (-1.5±0.1%)	**Complied.** Variation of the initial value is observed as 2%.
		7b. Longitudinal rail restraint shall be tested as per EN 13146-1-2012. Variation ≤ 20% of the initial value. Except the rail fastener, no sliding, yield cracking allowed for fastener parts. Longitudinal load/deformation curve shall fall the envelope upper and lower limit which is to be submitted along with the report.	**Complied.** Variation of the initial value is observed as (-17.7±0.2%)	**Complied.** Variation of the initial value is observed as 15%.
		7c. On clamping force shall be tested as per EN 13146-7-2012. Variation ≤ 20% of the initial value.	**Complied.** Variation of the initial value is observed as (-7.6±0.1%)	**Complied.** The clamping force did not change before and after repeated load test. Variation of the initial value is observed as 0%.
		Note: In case the acceptance criteria in the latest version of EN code is different from the values mentioned in Table-1 above, the acceptance criteria shall be as per the latest revision in EN Code.	**Noted**	**Noted**

Examined and found in order

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Asstt Directorate Approved on 08/10/2024 Railway Board

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PART B: SALIENT FEATURES OF FASTENING SYSTEM

S. No	Components/Items	Provision in CMRL			
1	Brief description of fastening system	Double Resilient Baseplate Assembly Fastening System is designed, manufactured and supplied by M/s. Pandrol Rahee Technology Pvt. Ltd are being used.		Fastening system 336 designed, manufactured and supplied by M/s. Vossloh Fastening Systems India Pvt. Ltd are being used.	
2	Axle load	16T		16T	
3	Speed potential	90Kmph		90Kmph	
4	Drawing and their numbers	Double Resilient Baseplate Assembly Fastening System, **"Drawing No 13145-Issue code 'C'". (Attached as Annexure 4)**		Fastening System 336, Drawing No.0.2424d, dated 18.10.2000 **(Attached as Annexure 9)**	
		Items	**Drg. No.**	**Items**	**Drg. No.**
		Baseplate	13146	Ribbed plate Rph 49/20/12 casted	1.3668
		Baseplate Pad	14613	Elastic pad Zwp 186-10/4	1.3872
		EVA Rail Pad	14614	Rail pad Zw 687	1.3873
		e2007 Pandrol Clip	2759	Tension clamp Skl 12	1.1979
		Insulator 8mm	5720	Intermediate pad Zwp 392/160/5	1.3712
		Insulator 6mm	8605	T-head bolt Hs 32	1.1139
		Insulator 10mm	8604	Washer Uls 6 and Uls 7	1.1138
		Eccentric Bush	12683	Insulating bush Fbu 6	1.2925
		Compression Spring	10108	Helical spring Fe28	1.2922
		Plastic Collard	12740	Collard washer Uls 10	1.2927

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S. No	Components/Items	Provision in CMRL			
		Washer			
		M27 Nyloc Nut	12791	Anchor bolt M27x285 with hexagon nut M27-8(self-locking)	1.3867
		M27 Anchor stud	12717		
5	Specification and their numbers	**Double Resilient Baseplate Assembly Fastening System,**		**Fastening System 336**	
		Item	**Spec. No.**	**Item**	**Clause No. in Annexure B of DMRC letter no. DMRC/20/11-336/2009, dated 11.08.2011**
		Baseplate	EC-K	Ribbed plate Rph (cast iron)	2.4
		Baseplate Pad	DC-E	Elastic pad Zwp 186	2.3
		EVA Rail Pad	DC-D	Rail pad Zw 687	2.8
		e2007 Pandrol Clip	A-A	Tension clamp Skl 12	2.10
		Insulator 8mm	BC-H	Intermediate pad Zwp 392	2.2
		Insulator 6mm	BC-H	T-head bolt Hs 32 with hexagon nut	2.9
		Insulator 10mm	BC-H	Washer Uls 6	2.11
		Eccentric Bush	GC-C	Insulating bush Fbu 6	2.5
		Compression Spring	KC-G	Helical spring Fe 28	2.6
		Plastic Collard Washer	GC-C	Collard washer Uls 10	2.7
		M27 Nyloc Nut	LC-B	Anchor bolt M27x285 with hexagon nut M27-8(self-locking)	2.1
		M27 Anchor stud	LC-B		
6	Any variation for straight and curve portion?	Two Bolts fastening system used for straight and curves radius flatter than		Two Bolts fastening system used for straight and curves Radius flatter than 1000m.	

Railway Board Directorate examined on 08/10/2024

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S. No	Components/Items	Provision in CMRL	
	If yes, give details.	1000m. Four Bolts fastening system used for curves radius ≤ 1000m.	Four Bolts fastening system used for curves radius ≤ 1000m.
7	Vertical stiffness of complete fastening system	24.7± 0.7kN/mm.	18.8kN/mm.
8	Service life of fastening system	The service life of the fastening as a unit is 30years, however the components such as e-clip and other plastic components service life is 15years or 300GMT whichever is earlier.	The service life of the fastening as a unit is 30years, however the components such as e-clip and other plastic components service life is 15years or 300GMT whichever is earlier.
9	Reference of Railway Board's approval for proposed fastening system	MoR Letter No.2003/proj/Bangalore/2/2(pt), dated 07.10.2011	MoR vide Letter No.98/Proj./DLI/30/1(Vol.III) dated 24.01.2013.

Examined and found in order

Pradeep Kr. Mishra

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Project Directorate Approved 08/10/2024 Railway Board

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PART C: CHECKLIST OF SUBMISSIONS

S.No.	Document Number	Document Name	CMRL Remarks	
			Double Resilient Baseplate Assembly Fastening System	Vossloh Fastening System 336
1	C 2.3.1	Compliance of Part A	Attached	Attached
2	C 2.3.2	Sets of drawings (two numbers)	Attached as Annexure - 4	Attached as Annexure - 9
3	C 2.3.3	Performance record of fastening system	Attached as Annexure -5	Attached as Annexure -10
4	C 2.3.4	Test report of fastening system	Attached as Annexure -3	Attached as Annexure -8

Examined and found in order

Pradeep Kr. Mishra

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